Inter-lamellar nano-structure and magnetic properties of soft magnetic metals for high frequency applications

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Soft magnetic composites have aroused much scientific interest because these materials exhibit good overall performance with high combined magnetic induction and permeability, low core loss and high working frequency, which are in latent demand for the application of power inductors, motors and generators. In this study, we fabricated new optimum soft magnetic composites having inter-lamellar structure manufactured by consecutive plasma carburization and heat treatment. We described the manufacturing process to make this soft magnetic composite, characterize the microstructure in detail, and explain the mechanism how the microstructure changes have an influence on the magnetic properties.

Our developed Fe/SiO_2 composite with lamellar structure shows the highest maximum Q factor at 14MHz and Q value is 170. Dense and fine inter-lamellar Fe_3C cementite walls which are observed prevent the eddy current from flowing and merging in the powder matrix and then separate total eddy currents as the frequency increases. We can also anticipate this microstructure and related manufacturing composite method can be easily applied to the mass production process of conventional power inductor, common mode filter, and high speed motor.

EDUCATION

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